Small Business Innovation Research/Small Business Tech Transfer

Bidirectional Dual Active Bridge Power Converter for Spacecraft Power Systems, Phase II

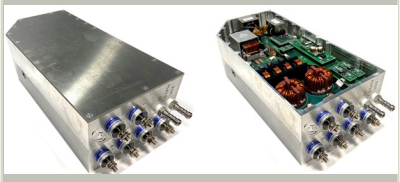
Completed Technology Project (2017 - 2020)

Project Introduction

A bidirectional dual active bridge (DAB) dc-dc converter for electrical power systems (EPS) is proposed. The converter operates as a charger, upconverter, and downconverter using a single transformer. The converter uses smart technology to interleave DAB converter stages for ripple current reduction and optimized load sharing of stages to extend the high efficiency load range of the converter to 6.25% of full load. By using smart technology, the load condition of each DAB converter stage is monitored and its load sharing controlled depending on the converters total load condition. In this way, each converter stage is kept at or above 25% load. Therefore the minimum load of the new DAB converter with four interleaved stages is one fourth of 25% or 6.25%. The design employs radiation-resistant and cryogenic-temperature-capable GaN HEMT devices to process 2 kW of power per stage. Mainstream has tested GaN HEMT devices to -225 C. GS66508T GaN HEMT devices are rated for 650 VDC maximum drain-to-source maximum voltage stress allowing for a maximum steady-operating voltage of 400 VDC at 60% derating.

Anticipated Benefits

Many NASA applications can benefit from incorporating the DAB converter into their electrical power systems. Spacecraft power systems can manage power sources with fewer power supplies. To charge on-board batteries and provide the high-voltage DC bus for motor inverters, the power systems of NASA electric vehicles, such as the Modular Robotic Vehicle and unmanned aerial vehicles, such as the Predator B, need compact, low-volume, low-mass dc-dc converters. The converter must also be bidirectional and multifunctional.Military vehicle, and helicopter starter-generator power systems also necessitate the use of small, compact, dc-dc converters. These applications also operate in extremely low temperature conditions of less than -55 C in artic, high elevation, and cold, high-altitude, environments. Therefore the DAB converter is an optimal solution for these applications.



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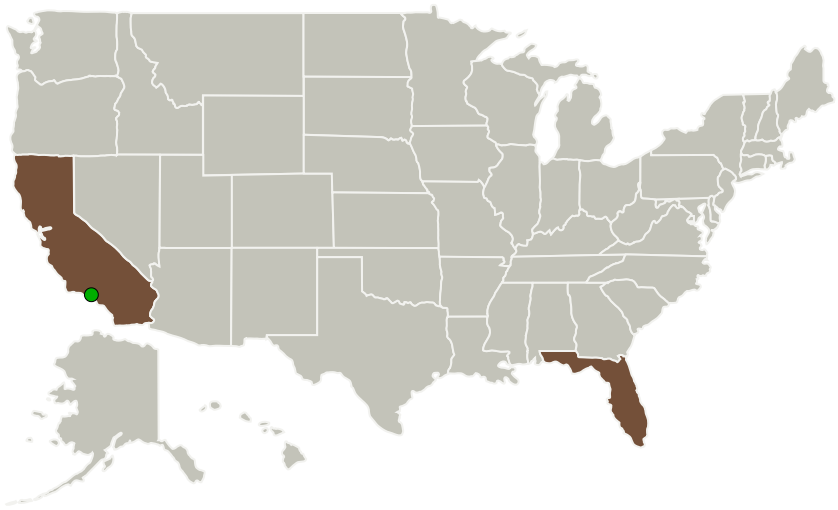
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Mainstream Engineering Corporation	Lead Organization	Industry	Rockledge, Florida
Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations	
California	Florida

Project Transitions

April 2017: Project Start

April 2020: Closed out

Closeout Documentation:

- Final Summary Chart PDF*(https://techport.nasa.gov/file/141042)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Mainstream Engineering Corporation

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Project Managers:

Robert A Jones
Carol R Lewis

Principal Investigator:

John Brothers

Bidirectional Dual Active Bridge Power Converter for Spacecraft Power Systems, Phase II

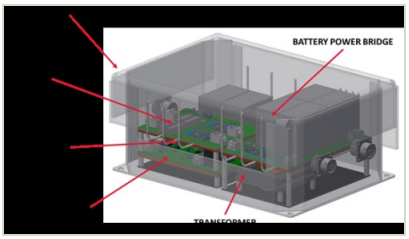
Completed Technology Project (2017 - 2020)

April 2020: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/141041)*

Images

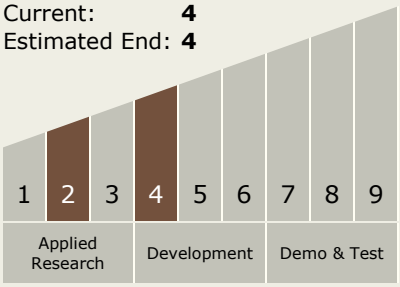


Briefing Chart Image
Bidirectional Dual Active Bridge Power Converter for Spacecraft Power Systems, Phase II Briefing Chart Image
(https://techport.nasa.gov/image/133772)

Final Summary Chart Image
Bidirectional Dual Active Bridge Power Converter for Spacecraft Power Systems, Phase II
(https://techport.nasa.gov/image/134239)

Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System